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Sir:

Enclosed for filing is an ☒ original patent application or, ☐ a continuation-in-part patent application, by inventor(s) Vipin Samar, entitled METHOD AND APPARATUS FOR SHARING A SECURE CONNECTION BETWEEN A CLIENT AND MULTIPLE SERVER NODES.

No. of pages in Specification: 24; No. of Claims: 35.

No. of Sheets of Drawings: Formal: 4, Informal: 0.

Also enclosed are:

- ☐ a claim for foreign priority under 35 U.S.C. §§ 119 and/or 365 in
- ☐ a separate document ☐ the declaration;
- ☐ a certified copy of the priority document;
- ☐ an Associate Power of Attorney;
- ☐ ___ verified statement(s) claiming small entity status;
- ☒ a Combined Declaration and Power of Attorney of the inventors(s);
- ☐ a signed Combined Declaration and Power of Attorney of the inventors will follow;
- ☒ an Assignment document and form PTO-1595;
- ☒ a Power of Attorney by Assignee; and
- ☐ Information Disclosure Statement and Form PTO-1449.

The fee has been calculated as follows:

| CLAIMS | | | | | |
|--|------------------|---------------|-----------------|----------|-------------------|
| | NO. OF CLAIMS | | EXTRA CLAIMS | RATE | FEE |
| Basic Application Fee | | | | | \$690.00 |
| Total Claims | 35 | MINUS 20 = | 15 | \$18.00= | \$270.00 |
| Independent Claims | 6 | MINUS 3 = | 3 | \$78.00= | \$234.00 |
| If multiple dependent claims are presented, add \$260.00 | | | | | 0 |
| Total Application Fee | | | | | \$1,194.00 |
| If verified statement claiming small entity status is enclosed, subtract 50% of Total Application Fee | | | | | |
| Add Recording Fee of \$40.00 if Assignment document is enclosed | | | | | \$40.00 |
| TOTAL APPLICATION FEE DUE | | | | | \$1,234.00 |

- ☒ [X] A check in the amount of \$ 1,234.00 is enclosed.
- ☐ [] Application fee will follow with missing parts.
- ☒ [X] Please deduct any underpayments or credit any overpayments to Deposit Account Number 50-1003.

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PATENT TRADEMARK OFFICE

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PATENT APPLICATION
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**METHOD AND APPARATUS FOR SHARING A
10 SECURE CONNECTION BETWEEN A CLIENT
AND MULTIPLE SERVERS**

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BACKGROUND

Field of the Invention

20 The present invention relates to connections between computer systems established across computer networks. More specifically, the present invention relates to a method and an apparatus for sharing a single secure connection with a client computer system between multiple servers, so that each of the multiple servers does not have to separately establish a secure connection with the client computing system.

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Related Art

The advent of computer networks has led to an explosion in the development of applications that facilitate rapid communication of information between computer systems.

One problem with sending information across computer networks is that it is hard to ensure that sensitive information is kept confidential. This is because a message containing sensitive information can potentially traverse many different computer networks, and many different computer systems, before it arrives at its ultimate destination. An adversary can potentially intercept a message at any of these intermediate points along the way.

One way to remedy this problem is to “encrypt” sensitive data using an encryption key so that only someone who possesses a corresponding decryption key can decrypt the data. (Note that for commonly used symmetric encryption mechanisms the encryption key and the decryption key are the same key.) For example, a person sending sensitive data across a computer network can encrypt the sensitive data using the encryption key before it is sent across a computer network. At the other end, a recipient of the data can use the corresponding decryption key to decrypt the data.

A number of protocols, such as the secure sockets layer (SSL) protocol, have been developed to establish secure communication channels across computer networks. The SSL protocol uses encryption and authentication techniques to ensure communications between a client and a server remain private. In establishing a SSL connection (or session) between a client and a server, the client and the server exchange a number of messages that: authenticate the server to the client (through use of a digital certificate); allow the client and the server to select cryptographic mechanisms that they both support; authenticate the client to the server (optional); use public-key encryption techniques to securely exchange shared secrets; and establish an encrypted SSL connection.

Unfortunately, there is presently no way to share the same SSL session across multiple servers within the same trusted web domain. Hence, applications

must set up and maintain a separate SSL connection on each server, which can greatly degrade scalability of the system.

Each secure SSL session can take anywhere between one half second to one second to establish. This is an enormously large time in comparison to the time required to establish a web connection of about 10-20 ms. Web sites currently solve this performance problem in a number of ways: by deploying large amounts of computational hardware; by limiting a service to few subscribers; or by hosting all security sensitive applications on the same machine, or by relaxing the security requirements on most of the web pages.

None of these solutions are acceptable for electronic commerce applications that require secure, scalable and modular systems in order to handle large volumes of traffic. For example, a medium-to-large electronic commerce site typically has a separate billing server, a separate account management server, a separate order server, and a separate customer management server. Furthermore, multiple instances of each of these servers may exist for load balancing and high availability purposes.

Aside from the performance problems arising from establishing secure connections, simply maintaining a public key infrastructure (PKI) revocation and authorization policy on every server can also create significant administration problems.

What is needed is a method and an apparatus that allows sharing of an established secure communication session across multiple servers.

SUMMARY

One embodiment of the present invention provides a system for sharing a secure communication session with a client between a plurality of servers. The system operates by receiving a message from the client at a first server. This

message includes a session identifier, which identifies a secure communication session with the client. If the session identifier does not correspond to an active secure communication session on the first server, the first server establishes an active secure communication session with the client by attempting to retrieve
5 security state information from a second server, which has an active secure communication session with the client. If the first server is able to retrieve this security state information, the first server uses this state information to establish the active secure communication session with the client without having to communicate with the client. If the first server is not able to retrieve this state
10 information, the first server communicates with the client to establish the secure communication session with the client.

In one embodiment of the present invention, the system attempts to retrieve the state information by attempting to use the session identifier to identify the second server, which had an active secure communication session with the
15 client. If such a second server is identified, the system attempts to retrieve the state information from the second server.

In one embodiment of the present invention, the system attempts to retrieve the state information from a centralized repository that is in communication with the plurality of servers. In a variation on this embodiment,
20 the centralized repository includes a database for storing the state information.

In one embodiment of the present invention, the active secure communication session is a secure sockets layer (SSL) connection with the client.

In one embodiment of the present invention, the state information includes a session encryption key for the secure communication session, the session
25 identifier for the secure communication session, and a running message digest for the secure communication session. In a variation on this embodiment, the system additionally uses the message to update the running message digest, and

checkpoints the updated running message digest to a location outside of the first server.

In one embodiment of the present invention, if the state information for the active secure communication session is retrieved, the system purges the state
5 information from a location from which the state information was retrieved, so that the state information cannot be subsequently retrieved by another server.

One embodiment of the present invention provides a system for sharing a secure communication session between a plurality of servers. This system operates by sending a message (including a session identifier) from a client to a
10 first server, which has no active secure communication session with the client. Next, the system receives a response to the message from the first server. If the response indicates that no active secure communication session has been created with the client on the first server, the system communicates with the first server to establish an active secure communication session.

15 In one embodiment of the present invention, the client sends the message to the first server only if an active secure communication session is held by a second server, wherein the second server has an address that is related to the address of the first server.

Hence, the present invention allows for sharing of secure communication
20 sessions (such as SSL sessions) across multiple servers, and thereby improves system scalability and performance.

BRIEF DESCRIPTION OF THE FIGURES

FIG. 1 illustrates a client in communication with a plurality of servers
25 across a computer network in accordance with an embodiment of the present invention.

FIG. 2 illustrates the structure of state information for a secure communication session in accordance with an embodiment of the present invention.

FIG. 3 is a flow chart illustrating how a client communicates with a server in accordance with an embodiment of the present invention.

FIG. 4 is a flow chart illustrating how a server sets up and maintains a new secure communication session in accordance with an embodiment of the present invention.

FIG. 5 is a flow chart illustrating how a server configures itself to use an existing secure communication session on another server in accordance with an embodiment of the present invention.

FIG. 6 is a flow chart illustrating how a server or other repository forwards communication session state information to a requesting server in accordance with an embodiment of the present invention.

DETAILED DESCRIPTION

The following description is presented to enable any person skilled in the art to make and use the invention, and is provided in the context of a particular application and its requirements. Various modifications to the disclosed embodiments will be readily apparent to those skilled in the art, and the general principles defined herein may be applied to other embodiments and applications without departing from the spirit and scope of the present invention. Thus, the present invention is not intended to be limited to the embodiments shown, but is to be accorded the widest scope consistent with the principles and features disclosed herein.

The data structures and code described in this detailed description are typically stored on a computer readable storage medium, which may be any device

or medium that can store code and/or data for use by a computer system. This includes, but is not limited to, magnetic and optical storage devices such as disk drives, magnetic tape, CDs (compact discs) and DVDs (digital video discs), and computer instruction signals embodied in a transmission medium (with or without
5 a carrier wave upon which the signals are modulated). For example, the transmission medium may include a communications network, such as the Internet.

Computer Systems

10 FIG. 1 illustrates a client 104 in communication with a plurality of related servers 111 across a computer network 108 in accordance with an embodiment of the present invention. In the embodiment illustrated in FIG. 1, user 102 accesses browser 106 on client 104 to communicate with a web site that is hosted by related servers 111.

15 Client 104 can include any node on a network including computational capability, and including a mechanism for communicating across network 108.

Browser 106 can include any type of web browser capable of viewing a web site, such the INTERNET EXPLORERTM browser distributed by the Microsoft Corporation of Redmond, Washington.

20 Network 108 can include any type of wire or wireless communication channel capable of coupling together computing nodes. This includes, but is not limited to, a local area network, a wide area network, or a combination of networks. In one embodiment of the present invention, network 108 includes the Internet.

25 Client 104 communicates with related servers 111 through redirector and/or router 110. Redirector and/or router 110 can include any type of mechanism that redirects communications from client 104 between related servers

111. This redirection can take place for a number of reasons, including for load balancing and/or fault tolerance purposes. In one embodiment of the present invention, redirector and/or router 110 is part of a high availability (HA) framework for the SOLARISTM operating system. The Solaris operating system is distributed by SUN Microsystems, Inc. of Palo Alto, California. In another embodiment of the present invention, redirector and/or router 110 is part of a load balancing system for related servers 111. In yet another embodiment, redirector and/or router 110 is part of one or more network routers.

In one embodiment of the present invention, related servers 111 communicate with database 124 in order to store information relating to established communication sessions (such as SSL connections) on related servers 111. This allows related servers 111 to share information on communication sessions, which enables related servers 111 to share communication sessions. In one embodiment of the present invention communications with database 124 adhere to the lightweight directory access protocol (LDAP), or alternatively a native protocol, such as the NET8TM protocol developed by the Oracle Corporation of Redwood Shores, California.

Related servers 111 can include any nodes on a computer network including a mechanism for servicing requests from a client for computational and/or data storage resources. In the embodiment illustrated in FIG. 1, related servers 111 cooperate with each other in order to provide electronic commerce services for client 104. To this end related servers 111 include: credit card server 112, which handles payments using credit card numbers; advertisement server 114, which handles computational activity related to providing advertising space on an electronic commerce web site; access control server 122, which handles security for related servers 111; login authentication servers 116-118, which handle the process of authenticating entities that communicate with related servers

111; and main web servers 128, which perform most of the web hosting functions and handle most of the web-related traffic from client computer systems. Note that all of the above-listed servers can be replicated for load balancing and/or fault-tolerance purposes. Also note that different parts of web pages can be stored on different servers.

During operation, the system illustrated in FIG. 1 operates generally as follows. Client 104 establishes a communication session (such as SSL session 130) with a login authentication server (such as login authentication server 116). Establishing this communication session involves a number of communications between client 104 and login authentication server 116 in order to authenticate client 104, and to set up a secure communication channel between client 104 and server 116. Login authentication server 116 makes state information 200 associated with SSL session 130 available to other servers in related servers 111 either by publishing the state information 200 in database 124, or by providing state information 200 to other servers when it is requested. This allows other servers within related servers 111 to use existing SSL session 130 without having to go through the time-consuming process of setting up a new communication session and all of the related public key cryptography.

Note that although the present invention is presented in the context of a SSL session 130 and a group of related servers 111 that provide a web site to client 104, the present invention is not limited to this context. In general, the present invention can be applied to any system in which a group of related computers are able to share information relating to an established communication session with another computer where the initial setup is extremely expensive.

Communication Session State Information

FIG. 2 illustrates the structure of state information 200 for a communication session in accordance with an embodiment of the present invention. Note that FIG. 2 illustrates some of the state information that is kept as part of an SSL session, such as SSL session 130 illustrated in FIG. 1. During initialization of the communication session, client 104 and server 116 agree on a session ID 202, which uniquely identifies the communication session. Note that the SSL protocol allows for resuming of the existing SSL session between client 104 and server 116 by including support for client 104 to send session ID 202 to server 116. One embodiment of the present invention uses this feature to send the session ID 202 to other "trusted" servers. (The notion of trust is implementation-specific but can include servers in the same domain, for example.)

As part of the SSL protocol, client 104 and server 116 also agree on a master secret 204, which contains various items including a read key 206 for encrypting communications from client 104 to server 116, and a write key 208 for encrypting communications in the other direction, from server 116 to client 104. It also contains a message digest key 210, which is used to encrypt the running message digest 212.

Running message digest 212 is also part of state information 200. Running message digest 212 contains a cumulative message digest for communications across SSL session 130. Note that running message digest 212 continually changes as messages are sent through SSL session 130. Hence, the current version of running message digest 212 must be available to any server that wants to share the communication session.

Operation of Client

FIG. 3 is a flow chart illustrating how a client 104 communicates with a server 118 in accordance with an embodiment of the present invention. Client 104 first decides to send a message to a server with which client 104 has no active communication session (such as server 118) (step 302). Next, client 104 determines if the address of server 118 is related to the address of another server with which client 104 has an active communication session (step 304). For example, in FIG. 1 client 104 may determine that the address of server 118 indicates that it is related to server 116, which has an active communication session 130 with client 104. Note that the addresses of servers 116 and 118 may be related in a number of ways, they may share the same domain name service (DNS) host name, they may have similar Internet Protocol (IP) addresses or they may have the same IP address, but different port numbers.

If client 104 determines the address of server 118 is not related to the address of a server that has an active communication session with client 104, client 104 starts a fresh connection with server 118 in order to establish an active communication session with server 118 (step 312).

If client 104 determines that the address is related to the address of a server that has an active communication session with client 104, client 104 sends a message including session ID 202 to server 118 (step 306). Next, client 104 receives an acceptance or a rejection of session ID 202 from server 118 (step 308).

If client 104 receives a rejection, client 104 communicates with server 118 in order to establish a new communication session with server 118 (step 312). If client 104 receives an acceptance, then server 118 was able to establish a communication session with client 104 using information from a related server.

Initializing and Maintaining a Communication Session

FIG. 4 is a flow chart illustrating how a server 116 sets up and maintains a new communication session client with a client 104 in accordance with an embodiment of the present invention. First, server 116 communicates with client 104 to set up the new communication session (for example SSL session 130 from FIG. 1) (step 402). Next, in one embodiment of the present invention, server 116 publishes state information 200 for SSL session 130 to a location outside of server 116 so that it is available to related servers that may want to share SSL session 130 (step 404). For example, server 116 may publish state information 200 for SSL session 130 to database 124. In an alternative embodiment, server 116 does not publish state information 200, but rather waits until state information 200 is requested by another server, and then sends state information 200 to the other server.

During operation, server 116 maintains state information 200 (step 406). This maintenance process includes updating running message digest 212 as messages pass through SSL session 130. In one embodiment of the present invention, server 116 publishes updates to running message digest 212 to database 124 so that other servers can share the updates (step 408).

Configuring Server to Use Existing Communication Session

FIG. 5 is a flow chart illustrating how a server 118 configures itself to use an existing communication session from another server in accordance with an embodiment of the present invention. Server 118 first receives a message from client 104 that contains session ID 202 (step 502). Server 118 next performs a lookup on session ID 202 to determine if the associated communication session (for example SSL session 130 from FIG. 1) is configured on server 118 (step

504). If so, the configuration process is complete aside from perhaps notifying client 104 that session ID 202 is valid.

If the associated communication session is not configured on server 118, the system attempts to retrieve state information 200 for the communication session (step 506). In one embodiment of the present invention, server 118 queries database 124 in order to retrieve state information 200. In another embodiment, server 118 queries another related server, such as server 116, to obtain state information 200. Server 118 can determine which server to query in a number of different ways, including through examining session ID 202 for an embedded server identifier, or by performing a lookup in database 124.

If server 118 is not able to retrieve state information 200, it must communicate with client 104 to establish a new communication session (step 514).

If server 118 is able to retrieve state information 200, it uses state information 200 to establish a communication session with client 104 (step 510).

Forwarding State Information

FIG. 6 is a flow chart illustrating how a server or other repository forwards communication session state information 200 to a requesting server in accordance with an embodiment of the present invention. In one embodiment of the present invention, the forwarding process illustrated in FIG. 6 applies to a database 124 that maintains communication session state information for active communication sessions held by related servers 111. In another embodiment, the forwarding process applies to a server 116 that forwards communication session state information to a requesting server 118.

The system starts by receiving a request for state information 200 from a requesting server 118 (step 602). The system then verifies that the requesting

server 118 is authorized to receive session state information 200 (step 604). This authorization can be performed through a number of mechanisms, including through a digital certificate, or by verifying that the other server 118 belongs to the same trusted domain.

5 If the other server 118 is not authorized, the system does not send state information 200 to requesting server 118.

 If the other server 118 is authorized, the system retrieves session state information 200 from local storage (step 608), and sends session state information 200 to the other server 118 (step 610).

10 The system then purges state information 200 from its local storage so that another server does not request and receive the same state information 200 (step 612).

 The foregoing descriptions of embodiments of the invention have been presented for purposes of illustration and description only. They are not intended
15 to be exhaustive or to limit the invention to the forms disclosed. Accordingly, many modifications and variations will be apparent to practitioners skilled in the art.

 Note that although the present invention is often described in terms of secure communication protocols, such as SSL, the present invention is not meant
20 to be limited to secure communication protocols, such as SSL. The present invention also applies to other secure communication protocols such as the transport layer security (TLS) protocol, and generally applies to all communication sessions (secure or non-secure) that require state information to be maintained at a server.

25 Additionally, the above disclosure is not intended to limit the present invention. The scope of the present invention is defined by the appended claims.

What Is Claimed Is:

1 1. A method for sharing a secure communication session with a client
2 between a plurality of servers, comprising:
3 receiving a message from the client at a first server in the plurality of
4 servers, the message including a session identifier that identifies a secure
5 communication session with the client; and
6 if the session identifier does not correspond to an active secure
7 communication session on the first server, establishing an active secure
8 communication session with the client on the first server by,
9 attempting to retrieve state information associated with the
10 session identifier for an active secure communication session
11 between the client and a second server from the plurality of
12 servers,
13 if the state information for the active secure communication
14 session is retrieved, using the state information to establish the
15 active secure communication session with the client without
16 having to communicate with the client, and
17 if the state information for the active secure communication
18 session is not retrieved, communicating with the client to establish
19 the active secure communication session with the client.

1 2. The method of claim 1, wherein attempting to retrieve the state
2 information includes:
3 attempting to use the session identifier to identify the second server in the
4 plurality of servers that has an active secure communication session with the
5 client that corresponds to the session identifier; and

6 attempting to retrieve the state information from the second server.

1 3. The method of claim 1, wherein attempting to retrieve the state
2 information involves attempting to retrieve the state information from a
3 centralized repository that is in communication with the plurality of servers.

1 4. The method of claim 3, wherein the centralized repository includes
2 a database for storing the state information.

1 5. The method of claim 1, wherein establishing the active secure
2 communication session involves establishing a secure sockets layer (SSL)
3 connection with the client.

1 6. The method of claim 1, wherein the state information includes:
2 a session encryption key for the secure communication session;
3 the session identifier for the secure communication session; and
4 a running message digest for the secure communication session.

1 7. The method of claim 6, further comprising:
2 using the message to update the running message digest; and
3 checkpointing the updated running message digest to a location outside of
4 the first server.

1 8. The method of claim 1, further comprising, if the state information
2 for the active secure communication session is retrieved, purging the state
3 information from a location from which the state information was retrieved, so

4 that the state information cannot be subsequently retrieved by another server in the
5 plurality of servers.

1 9. The method of claim 1, further comprising initially establishing an
2 active secure communication session between the client and the second server, the
3 active secure communication session being identified by the session identifier.

1 10. The method of claim 1, wherein attempting to retrieve the state
2 information includes authenticating and authorizing the first server.

1 11. A method for sharing a secure communication session between a
2 plurality of servers, comprising:
3 sending a message from a client to a first server in the plurality of servers,
4 the first server having no active secure communication session with the client, the
5 message including a session identifier;
6 receiving a response to the message from the first server; and
7 if the response indicates that no active secure communication session has
8 been created with the client on the first server, communicating with the first server
9 to establish an active secure communication session.

1 12. The method of claim 11, wherein the client sends the message to
2 the first server only if an active secure communication session is held by a second
3 server in the plurality of servers, wherein the second server has an address that is
4 related to the address of the first server.

1 13. A computer-readable storage medium storing instructions that
2 when executed by a computer cause the computer to perform a method for sharing

3 a secure communication session with a client between a plurality of servers, the
4 method comprising:

5 receiving a message from the client at a first server in the plurality of
6 servers, the message including a session identifier that identifies a secure
7 communication session with the client; and

8 if the session identifier does not correspond to an active secure
9 communication session on the first server, establishing an active secure
10 communication session with the client on the first server by,

11 attempting to retrieve state information associated with the
12 session identifier for an active secure communication session
13 between the client and a second server from the plurality of
14 servers,

15 if the state information for the active secure communication
16 session is retrieved, using the state information to establish the
17 active secure communication session with the client without
18 having to communicate with the client, and

19 if the state information for the active secure communication
20 session is not retrieved, communicating with the client to establish
21 the active secure communication session with the client.

1 14. The computer-readable storage medium of claim 13, wherein
2 attempting to retrieve the state information includes:

3 attempting to use the session identifier to identify the second server in the
4 plurality of servers that has an active secure communication session with the
5 client that corresponds to the session identifier; and

6 attempting to retrieve the state information from the second server.

1 15. The computer-readable storage medium of claim 13, wherein
2 attempting to retrieve the state information involves attempting to retrieve the
3 state information from a centralized repository that is in communication with the
4 plurality of servers.

1 16. The computer-readable storage medium of claim 15, wherein the
2 centralized repository includes a database for storing the state information.

1 17. The computer-readable storage medium of claim 13, wherein
2 establishing the active secure communication session involves establishing a
3 secure sockets layer (SSL) connection with the client.

1 18. The computer-readable storage medium of claim 13, wherein the
2 state information includes:
3 a session encryption key for the secure communication session;
4 the session identifier for the secure communication session; and
5 a running message digest for the secure communication session.

1 19. The computer-readable storage medium of claim 18, wherein the
2 method further comprises:
3 using the message to update the running message digest; and
4 checkpointing the updated running message digest to a location outside of
5 the first server.

1 20. The computer-readable storage medium of claim 13, wherein the
2 method further comprises, if the state information for the active secure
3 communication session is retrieved, purging the state information from a location

4 from which the state information was retrieved, so that the state information
5 cannot be subsequently retrieved by another server in the plurality of servers.

1 21. The computer-readable storage medium of claim 13, wherein the
2 method further comprises initially establishing an active secure communication
3 session between the client and the second server, the active secure communication
4 session being identified by the session identifier.

1 22. The computer-readable storage medium of claim 13, wherein
2 attempting to retrieve the state information includes authenticating and
3 authorizing the first server.

1 23. A computer-readable storage medium storing instructions that
2 when executed by a computer cause the computer to perform a method for sharing
3 a secure communication session between a plurality of servers, comprising:
4 sending a message from a client to a first server in the plurality of servers,
5 the first server having no active secure communication session with the client, the
6 message including a session identifier;
7 receiving a response to the message from the first server; and
8 if the response indicates that no active secure communication session has
9 been created with the client on the first server, communicating with the first server
10 to establish an active secure communication session.

1 24. The computer-readable storage medium of claim 23, wherein the
2 client sends the message to the first server only if an active secure communication
3 session is held by a second server in the plurality of servers, wherein the second
4 server has an address that is related to the address of the first server.

1 25. An apparatus that shares a secure communication session with a
2 client between a plurality of servers, comprising:
3 a receiving mechanism, at a first server in the plurality of servers, that
4 receives a message from the client, the message including a session identifier that
5 identifies a secure communication session with the client;
6 an examination mechanism that examines the session identifier; and
7 a session initialization mechanism, on the first server, wherein if the
8 session identifier does not correspond to an active secure communication session
9 on the first server, the session initialization mechanism is configured to establish
10 an active secure communication session with the client by,
11 attempting to retrieve state information associated with the
12 session identifier for an active secure communication session
13 between the client and a second server from the plurality of
14 servers,
15 if the state information for the active secure communication
16 session is retrieved, using the state information to establish the
17 active secure communication session with the client without
18 having to communicate with the client, and
19 if the state information for the active secure communication
20 session is not retrieved, communicating with the client to establish
21 the active secure communication session with the client.

1 26. The apparatus of claim 25, wherein the session initialization
2 mechanism is configured to attempt to retrieve the state information by:

3 attempting to use the session identifier to identify the second server in the
4 plurality of servers that has an active secure communication session with the
5 client that corresponds to the session identifier; and
6 attempting to retrieve the state information from the second server.

1 27. The apparatus of claim 25, wherein the session initialization
2 mechanism is configured to attempt to retrieve the state information by attempting
3 to retrieve the state information from a centralized repository that is in
4 communication with the plurality of servers.

1 28. The apparatus of claim 27, wherein the centralized repository
2 includes a database for storing the state information.

1 29. The apparatus of claim 25, wherein the active secure
2 communication session includes a secure sockets layer (SSL) connection with the
3 client.

1 30. The apparatus of claim 25, wherein the state information includes:
2 a session encryption key for the secure communication session;
3 the session identifier for the secure communication session; and
4 a running message digest for the secure communication session.

1 31. The apparatus of claim 30, further comprising an updating
2 mechanism that is configured to:
3 use the message to update the running message digest; and to
4 checkpoint the updated running message digest to a location outside of the
5 first server.

1 32. The apparatus of claim 25, further comprising a purging
2 mechanism that is configured to purge the state information from a location from
3 which the state information was retrieved, so that the state information cannot be
4 subsequently retrieved by another server in the plurality of servers.

1 33. The apparatus of claim 25, wherein the session initialization
2 mechanism is configured to authenticate and authorize the first server prior to
3 receiving the state information.

1 34. An apparatus that facilitates sharing a secure communication
2 session between a plurality of servers, comprising:
3 a sending mechanism that sends a message from a client to a first server in
4 the plurality of servers, the first server having no active secure communication
5 session with the client, the message including a session identifier;
6 a receiving mechanism that receives a response to the message from the
7 first server; and
8 a session initialization mechanism that communicates with the first server
9 to establish an active secure communication session with the first server if the
10 response indicates that no active secure communication session has been created
11 with the client on the first server.

1 35. The apparatus of claim 34, wherein the sending mechanism sends
2 the message to the first server only if an active secure communication session is
3 held by a second server in the plurality of servers, wherein the second server has
4 an address that is related to the address of the first server.

METHOD AND APPARATUS FOR SHARING A SECURE CLIENT CONNECTION BETWEEN MULTIPLE SERVERS

ABSTRACT

One embodiment of the present invention provides a system for sharing a secure communication session with a client between a plurality of servers. The system operates by receiving a message from the client at a first server. This message includes a session identifier, which identifies a secure communication session with the client. If the session identifier does not correspond to an active secure communication session on the first server, the first server establishes an active secure communication session with the client by attempting to retrieve security state information from a second server, which had an active secure communication session with the client. If the first server is able to retrieve this security state information, the first server uses this state information to establish the active secure communication session with the client without having to communicate with the client. If the first server is not able to retrieve this state information, the first server communicates with the client to establish the secure communication session with the client.

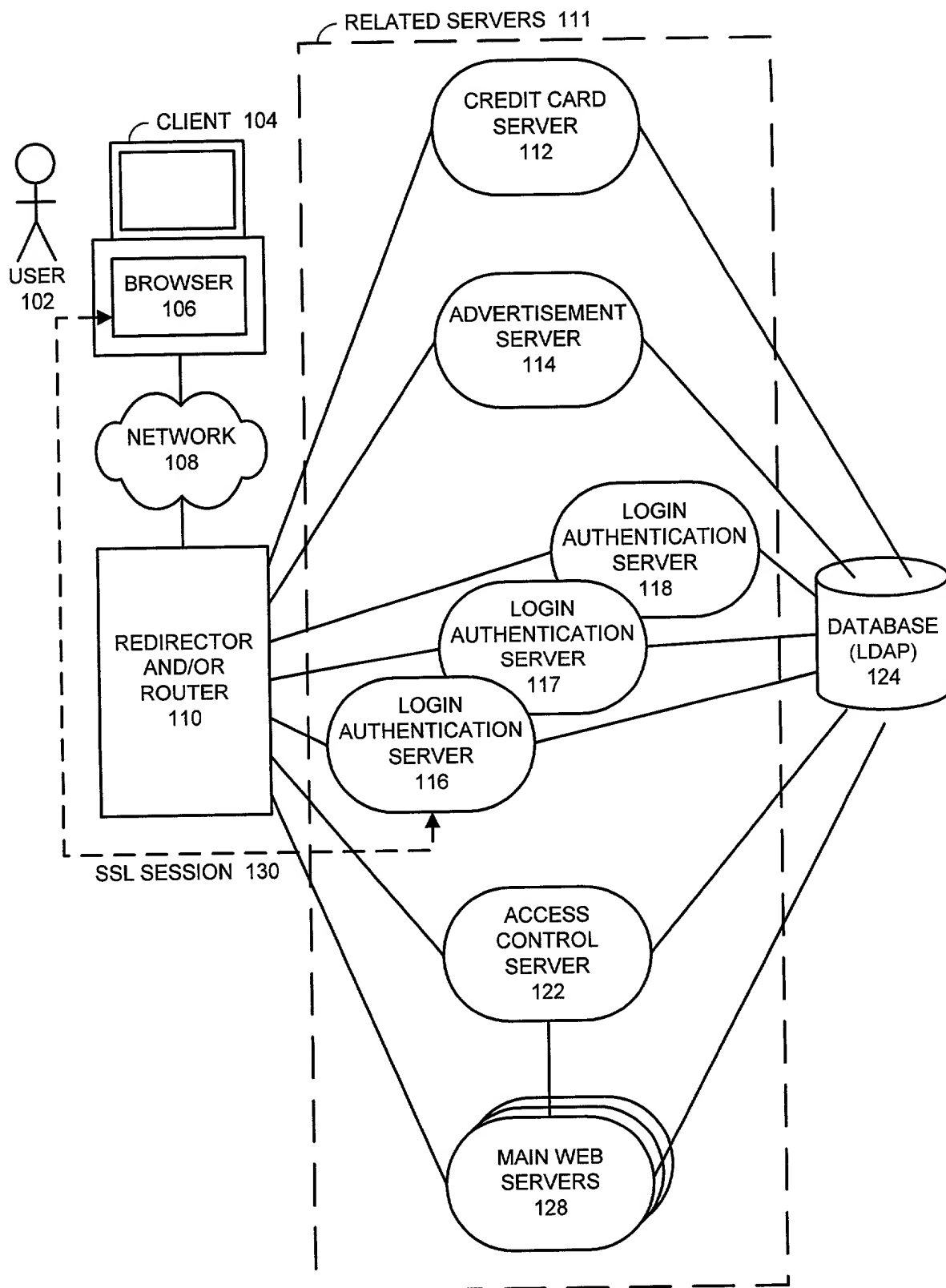


FIG. 1

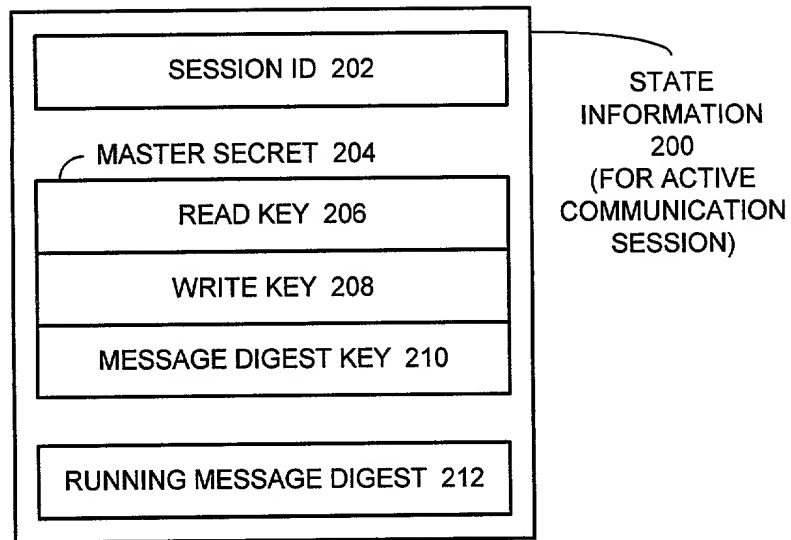


FIG. 2

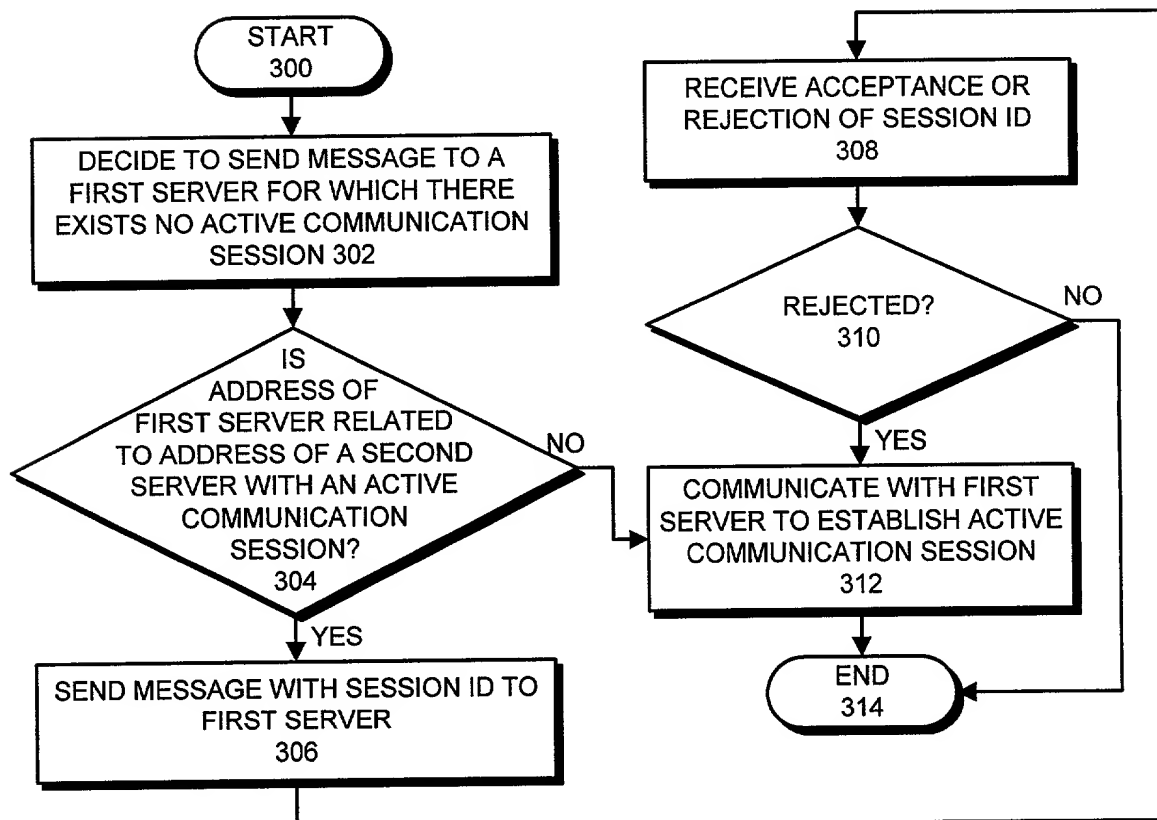


FIG. 3

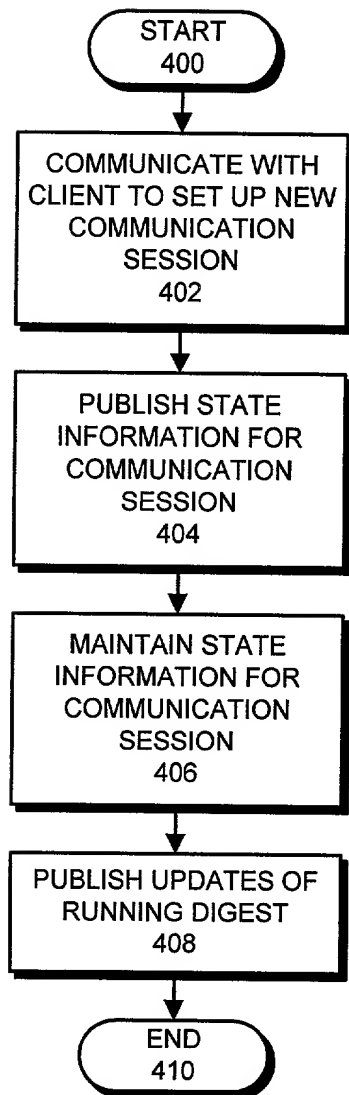


FIG. 4

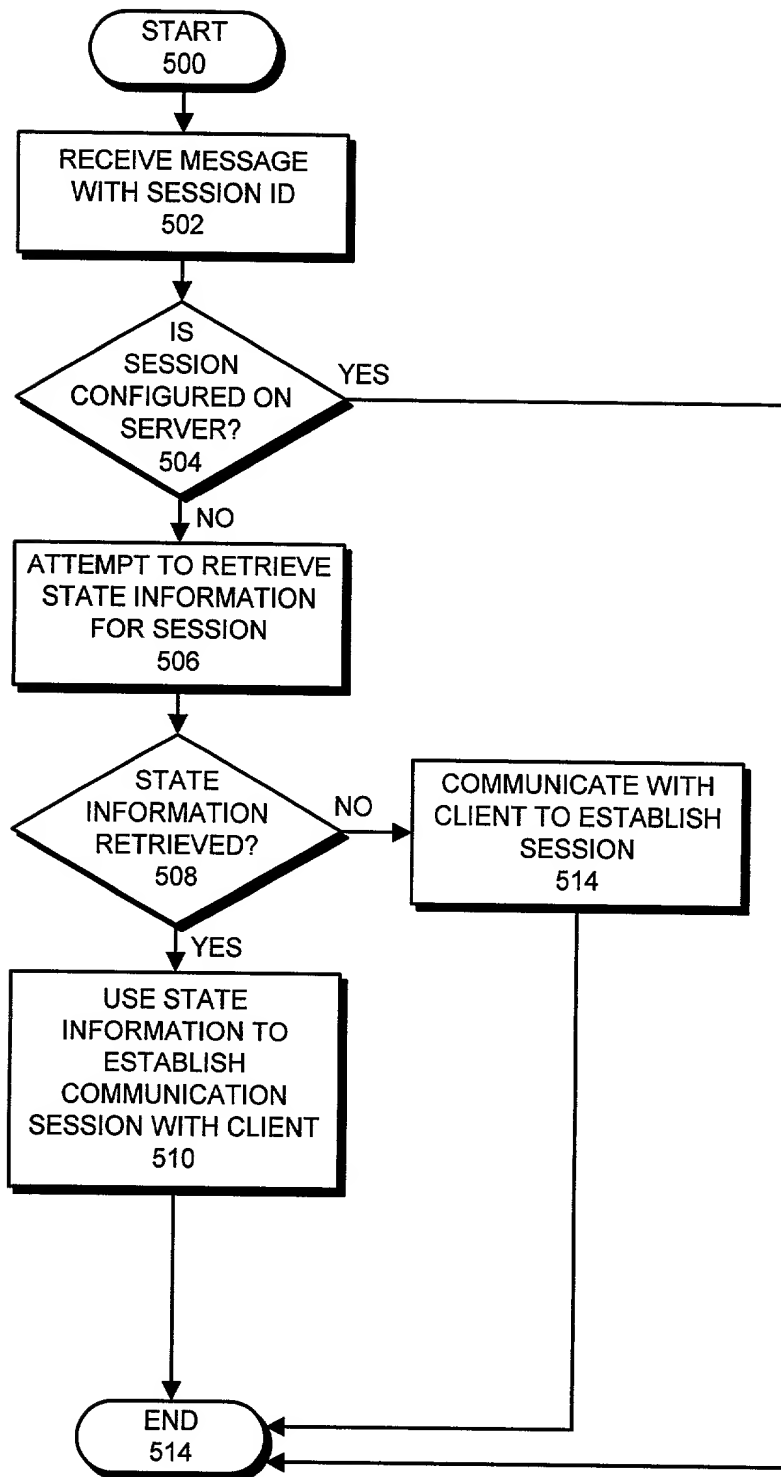


FIG. 5

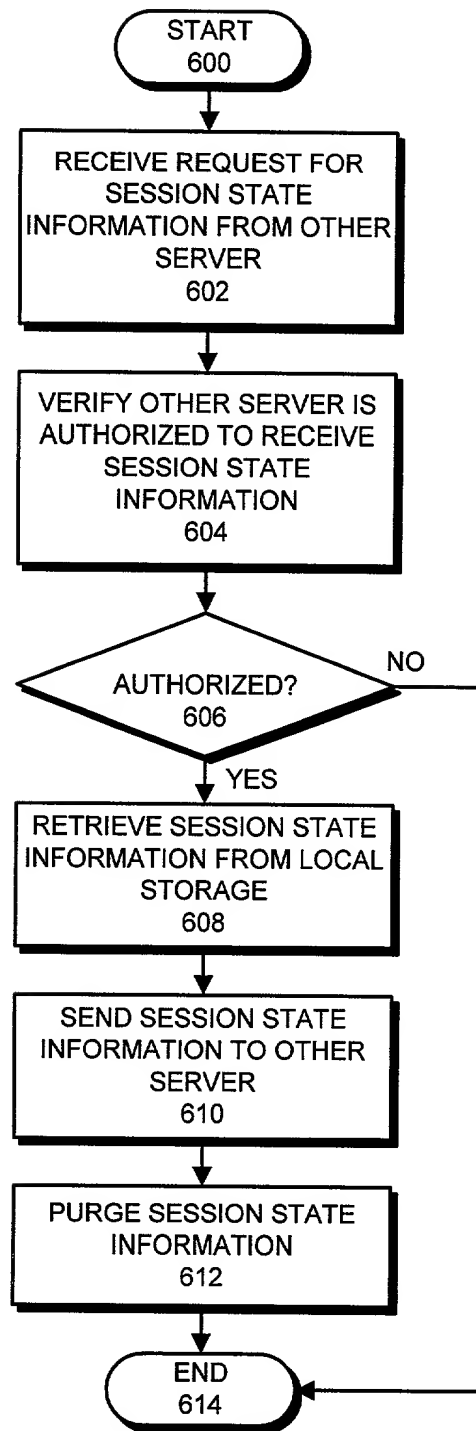


FIG. 6

COMBINED DECLARATION AND POWER OF ATTORNEY

As a below-named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below by my name;

I believe I am the original, first and sole inventor, if only one name is listed below, or an original, first and joint inventor if multiple names are listed below, of the subject matter which is claimed and for which a patent is sought on the invention entitled:

METHOD AND APPARATUS FOR SHARING A SECURE CONNECTION BETWEEN A CLIENT AND MULTIPLE SERVER NODES

for which a patent application:

☒ is attached hereto.

☐ was filed in the United States on _ as Application No. _;

☐ with amendment(s) filed on _____ (if applicable).

I hereby state that I have reviewed and understand the contents of the application identified above, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information known to me to be material to the examination of this application in accordance with Title 37, Code of Federal Regulations, §1.56, which states in relevant part:

Each individual associated with the filing and prosecution of a patent application has a duty of candor and good faith in dealing with the Office, which includes a duty to disclose to the Office all information known to that individual to be material to patentability as defined in this section.... The duty to disclose all information known to be material to patentability is deemed to be satisfied if all information known to be material to patentability of any claim issued in a patent was cited by the Office or submitted to the Office..

I hereby claim foreign priority benefits under Title 35, United States Code, §119(a)-(d), of any foreign application(s) for patent or inventor's certificate as indicated below and have also identified below any foreign application for patent or inventor's certificate on this invention having a filing date before that of the application on which priority is claimed:

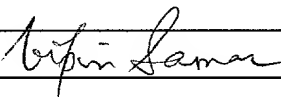
| EARLIEST FOREIGN APPLICATION(S), IF ANY, FILED PRIOR TO THE FILING DATE OF THE APPLICATION | | | |
|--|---------|--------------------------------------|--|
| APPLICATION NUMBER | COUNTRY | DATE OF FILING (Day, Month, Year) | PRIORITY CLAIMED |
| | | | YES <input type="checkbox"/> NO <input type="checkbox"/> |

I hereby claim the benefit under Title 35, United States Code, §119(e), of any United States provisional application(s) listed below:

| APPLICATION NUMBER | DATE OF FILING |
|--------------------|----------------|
| | |

I hereby claim the benefit under Title 35, United States Code, §120, of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose information that is material to patentability as defined in Title 37, Code of Federal Regulations, §1.56, which became available between the filing date of the prior application and the national or PCT international filing date of this application:

| APPLICATION NUMBER | DATE OF FILING | STATUS | | |
|--------------------|----------------|----------|---------|-----------|
| | | PATENTED | PENDING | ABANDONED |

| | | | |
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| | Postal Address (if different from Residence) | | |
| | Signature and Date |  | Date 3-21-00 |
| 2 | Name and Citizenship | | |
| | Residence Address | | |
| | Postal Address (if different from Residence) | | |
| | Signature and Date | | Date |
| 3 | Name and Citizenship | | |
| | Residence Address | | |
| | Postal Address (if different from Residence) | | |
| | Signature and Date | | Date |
| 4 | Name and Citizenship | | |
| | Residence Address | | |
| | Postal Address (if different from Residence) | | |
| | Signature and Date | | Date |
| 5 | Name and Citizenship | | |
| | Residence Address | | |
| | Postal Address (if different from Residence) | | |
| | Signature and Date | | Date |

Additional inventor name(s) and signature(s) attached?: YES ☐ NO ☒

**POWER OF ATTORNEY BY ASSIGNEE TO EXCLUSION OF INVENTOR UNDER
37 C.F.R. § 3.71 WITH REVOCATION OF PRIOR POWERS**

| | |
|-----------------|---|
| Inventor(s): | Vipin Samar |
| Title: | METHOD AND APPARATUS FOR SHARING A SECURE CONNECTION BETWEEN A CLIENT AND MULTIPLE SERVER NODES |
| Docket No: | OR99-17401 |
| Serial No. | To Be Assigned |
| Filing Date: | To Be Assigned |
| Group Art Unit: | To Be Assigned |
| Examiner: | To Be Assigned |

The undersigned ASSIGNEE of the entire interest in the above-identified application for letters patent hereby appoints Sanjay Prasad, Registration No. 36,247, Roger P. Kennedy, Registration No. 44,823 and Christopher Brokaw, Registration No. P-45,620 of ORACLE CORPORATION, and A. Richard Park, Registration No. 41,241 and Daniel E. Vaughan, Registration No. 42,199 of PARK & VAUGHAN LLP, to prosecute this application and transact all business in the United States and Trademark Office in connection therewith and hereby revokes all prior powers of attorney; said appointment to be to the exclusion of the inventors and the inventors' attorneys in accordance with the provisions of 37 C.F.R. § 3.71.

The following evidentiary documents establish a chain of title from the original owner to the Assignee:

 x a copy of an Assignment attached hereto, which Assignment has been (or is herewith) forwarded to the Patent and Trademark Office for recording; or

the Assignment recorded on _____ at reel _____, frames _____ - _____.

Pursuant to 37 C.F.R. § 3.73(b) the undersigned Assignee hereby states that evidentiary documents have been reviewed and hereby certifies that, to the best of ASSIGNEE's knowledge and belief, title is in the identified ASSIGNEE.

Please direct all telephone calls and correspondence to: A. Richard Park, Park & Vaughan LLP, 508 Second Street Suite 201, Davis, CA 95616, tel: (530) 759-1661.

ASSIGNEE: Oracle Corporation

Signature:

(Signature)

$$3 \overline{) 23100}$$

(Date)

Name: Sanjay Prasad

Title: Chief Patent Counsel